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IN THE UNITED STATES  
PATENT AND TRADEMARK OFFICE

PATENT APPLICATION

Ashok N. Rudrapatna  
Mehmet Oguz Sunay

CASE 15-5

TITLE Dynamic Reassignment Of Code Space Among Multiple Modes Of Operation

ASSISTANT COMMISSIONER FOR PATENTS  
WASHINGTON, D.C. 20231

SIR:

NEW APPLICATION UNDER 37 CFR § 1.53(b)

Enclosed are the following papers relating to the above-named application for patent:

Specification  
3 Informal Sheets of drawings  
Assignment with Cover Sheet  
Declaration and Power of Attorney

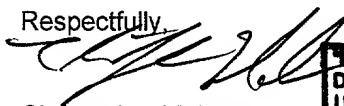
CLAIMS AS FILED				
	NO. FILED	NO. EXTRA	RATE	CALCULATIONS
Total Claims	18 - 20 =	0	x \$18 =	\$0
Independent Claims	4 - 3 =	1	x \$78 =	\$78
Multiple Dependent Claims, if applicable			+ \$260 =	\$0
Basic Fee				\$690
			<b>TOTAL FEE</b>	<b>\$768</b>

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The Assistant Commissioner for Patents is hereby authorized to treat any concurrent or future reply, requiring a petition for extension of time under 37 CFR § 1.136 for its timely submission, as incorporating a petition for extension of time for the appropriate length of time if not submitted with the reply.

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Respectfully,

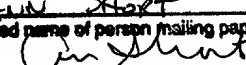
  
Christopher Malvone  
Reg. No. 34866  
Attorney for Applicants

SEP 12 2000

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**DYMANIC REASSIGNMENT OF CODE SPACE AMONG**  
**MULTIPLE MODES OF OPERATION**

5     **Related Applications**

Related subject matter is disclosed in the following application filed concurrently herewith and assigned to the same assignee hereof: U.S. Patent Application entitled "Code Space Sharing Among Multiple Modes Of Operation", Serial No. \_\_\_\_.

10    **Background of the Invention**

1.   **Field of the Invention**

The present invention relates to communications; more specifically, wireless communications.

15

2.   **Description of the Related Art**

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In some wireless communication systems, channels are distinguished using orthogonal codes such as Walsh codes that are assigned from a collection of codes that constitute a code space. Typically each user is given full time access to a subspace of the code space such as one or more Walsh codes until the communication session is ended by, for example, a handoff, a dropped call or an end of call. This type of use of the code space is inefficient in multiple mode operations such as in systems supporting both voice and data users.

**Summary of the Invention**

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The present invention divides the code space associated with the communication system into two subspaces where each subspace is assigned to a different mode of operation. In one mode, such as a voice mode, each user is given full time access to a portion of the subspace associated with that mode of operation. In a second mode, such as a data mode, each user uses the entire subspace associated with that mode on a time shared basis. Additionally, in-sector handoffs from one Walsh code to another are used to more efficiently distribute the code space.

30

**Brief Description of the Drawings**

FIG. 1 illustrates Walsh matrices;

FIG. 2 illustrates a Walsh matrix of order 4;

FIG. 3 illustrates the derivation paths for different Walsh spaces;

FIG. 4 illustrates the relationship between portions of a 128 Walsh code code space; and

FIG. 5 illustrates the distribution of code space between two modes of operation.

5

### **Detailed Description**

Walsh codes have the distinctive property that higher Walsh space codes can be derived from the lower Walsh space codes.

FIG. 3 illustrates a Walsh matrix of order 1 and order 2, and a Walsh matrix of order  $2n$ .

10 The rows of the matrix are the Walsh codes composing the Walsh space. The relationship between a Walsh matrix of order  $n$  and order  $2n$  is a recursive relationship and is used to easily produce larger order Walsh matrices. For example, in creating a Walsh matrix of order 4, the Walsh matrix of order 2 is inserted into the upper left hand corner, the upper right hand corner, and the lower left hand corner of the Walsh matrix of order 4. The bar version of the Walsh  
15 matrix of order 2 is inserted into the lower right hand corner of the Walsh matrix of order 4. The bar version of the matrix is formed by taking the logical inverse of each element of the matrix.

FIG. 2 illustrates a Walsh matrix of order 4.

Orthogonality across codes from different spaces is possible as long as two codes that are in the same derivation path are not selected simultaneously. Consider FIG. 3. Here, a code from  
20 the Walsh space of Walsh-16 is used to derive two codes from the Walsh space of Walsh-32. Likewise, each Walsh code from the Walsh-32 space is used to create two codes from the Walsh-64 space and so on. In the figure  $W_{x,y}$  represents the  $y$ 'th Walsh code form the Walsh space of Walsh- $x$ . Now, from the figure, one can see that, for example, while  $W_{32,1}$  and  $W_{64,3}$  are orthogonal,  $W_{32,1}$  and  $W_{64,2}$  are not.

25 When assigning code space to mode one users, such as voice users, and assigning other code space to mode two users, such as data users, it is desirable to divide the codes in large blocks that originate from a lower order Walsh code such as a 16 symbol code. By assigning the subspaces in groups originating from lower order Walsh codes, a receiver's design is simplified by requiring fewer decoding paths to receive transmissions. For example, in a system using 128  
30 symbol Walsh codes, it is desirable to assign the codes to the subspaces in groups of 8 consecutive codes so that a receiver would only need 16 decoding paths to receive transmissions.

In reference to FIG. 4, an initial set of subspace assignments may be with  $W_{128,1}$  through  $W_{128,8}$  being assigned to mode 1 operations while the remaining Walsh codes are assigned to the mode 2 (Walsh codes  $W_{128,9}$  through  $W_{128,128}$ ). It should be noted that the code spaces have been divided into subspaces originating from 16 symbol Walsh codes which allows a receiver to use 16 decoding paths to receive transmissions. In the mode 1 subspace one or more codes are assigned to each user on a full time basis or until communications are complete with that user. In the mode 2 subspace, all of the codes are assigned to a single user on a time shared or time multiplexed basis. For example, each of  $n$  users may use the entire mode 2 code subspace for  $1/n$  of the time.

It is also possible to distribute the codes among the mode 1 and mode 2 subspaces on a dynamic basis. For example, if one code in the mode 1 subspace is not being used, it may be assigned to the mode 2 subspace; however, this is subject to the code from the mode 1 subspace being orthogonal to all of the other codes in the mode 2 subspace. If more codes in the mode 1 subspace are unused, they may be assigned to the mode 2 subspace as well, but once again subject to the codes from the mode 1 subspace being orthogonal to all of the other codes presently in use in the mode 2 subspace. Similarly, unused codes in the mode 2 subspace may be assigned to the mode 1 subspace subject to the codes from the mode 2 subspace being orthogonal to all of the codes presently in use in the mode 1 subspace. Information regarding the current set of code assignments may be transmitted by a base station to users as well as other base stations using communication channels such as control channels or paging channels.

FIG. 5 illustrates the distribution of codes between the mode 1 and mode2 subspaces. Portion 10 may be assigned to the mode 1 subspace while portion 20 is assigned to the mode 2 subspace. It should be noted that a guardband 30 is provided where codes are not assigned to either subspace. This guardband allows the mode 1 or mode 2 subspaces to expand without immediately removing a code from the other subspace. After some of the codes in the guardband are assigned to one of the subspaces, the guardband is expanded to its original size by taking codes from either subspace as they become available. Additionally, each of the code spaces may be assigned a minimum number of codes indicated by bands 40. These bands guarantee that each of the mode 1 and mode 2 subspaces always have a minimum number of codes for operation.

The utilization of the code space is dynamically changing because user traffic streams (calls or data sessions of either mode-1 or mode-2 type) arrive and depart. This can cause fragmentation of the code space thus unnecessarily blocking user traffic from fully utilizing all

available code space. For example and in reference to FIG. 4, consider a situation where only  $W_{128,3}$  (from  $W_{16,1}$  subspace) and  $W_{128,10}$  (from  $W_{16,2}$  subspace) are being used by mode-1 users. In this case, only 14 mode-2 Walsh code ( $W_{16}$ ) space is available for allocation to mode-2 users. However, if the mode-1  $W_{128,10}$  user is transferred to be in the same subspace as  $W_{128,3}$  (from  $W_{16,1}$  subspace), then one more  $W_{16}$  Walsh code ( $W_{16,2}$ ) would be available for mode-2 users, thus improving its performance. To accomplish this an in-sector handoff from one Walsh code to another is executed. An in-sector handoff is a handoff within the same sector of the same cell. As an illustration in the above scenario, a  $W_{128,10}$  user would be handed off to  $W_{128,2}$ . The handoff is executed using the same procedure or a procedure similar to a handoff between different sectors of the same cell or between sectors of different cells. It should be noted that a handoff between Walsh codes may also be between different sectors of the same cell or between sectors of different cells.

**The invention claimed is:**

- 1           1. A method for partitioning code space in a communication system, comprising the steps  
2 of:  
3           dividing a code space into at least two subspaces, where codes in the first subspace are  
4 assigned to at least one user at a time for a communication session and where all of the codes in  
5 the second subspace are assigned to one user;  
6           assigning a first code to a user currently using a second code in one subspace; and  
7           performing an in-sector handoff of the user from the second code to the first code.
- 1           2. The method of claim 1, further comprising the step of assigning the second code to a  
2 different subspace.
- 1           3. The method of claim 2, wherein the user is using the second code in the first subspace.
- 1           4. The method of claim 1, wherein the first subspace is used for voice communication.
- 1           5. The method of claim 1, wherein the second subspace is used for data communication.
- 1           6. A method for partitioning code space in a communication system, comprising the steps  
2 of:  
3           dividing a code space into at least two subspaces, where codes in the first subspace are  
4 assigned to at least one user at a time for a communication session and where all of the codes in  
5 the second subspace are assigned to one user;  
6           assigning a first code to a user currently using a second code in one subspace;  
7           handing off the user from the second code to the first code; and  
8           assigning the second code to a different subspace.
- 1           7. The method of claim 6, wherein the user is using the second code in the first subspace.
- 1           8. The method of claim 6, wherein the first subspace is used for voice communication.
- 1           9. The method of claim 6, wherein the second subspace is used for data communication.

1           10. A method for partitioning code space in a communication system, comprising the  
2 steps of:  
3           dividing a code space into at least two subspaces, where codes in the first subspace are  
4 assigned to at least one user at a time for a communication session and where all of the codes in  
5 the second subspace are assigned to one of a plurality of users on a time shared basis:  
6 assigning a first code to a user currently using a second code in one subspace; and  
7           handing off the user from the second code to the first code; and  
8           assigning the second code to a different subspace.

1           11. The method of claim 10, wherein the user is using the second code in the first  
2 subspace.

1           12. The method of claim 10, wherein the first subspace is used for voice communication.

1           13. The method of claim 10, wherein the second subspace is used for data  
2 communication.

1           14. A method for partitioning code space in a communication system, comprising the  
2 steps of:  
3           dividing a code space into at least two subspaces, where codes in the first subspace are  
4 assigned to at least one user at a time for a communication session and where all of the codes in  
5 the second subspace are assigned to one of a plurality of users on a time shared basis;  
6           assigning a first code to a user currently using a second code in one subspace; and  
7           performing an in-sector handoff of the user from the second code to the first code.  
8

1           15. The method of claim 14, further comprising the step of assigning the second code to  
2 a different subspace.

1           16. The method of claim 15, wherein the user is using the second code in the first  
2 subspace.

1           17. The method of claim 14, wherein the first subspace is used for voice communication.

- 1 18. The method of claim 14, wherein the second subspace is used for data
- 2 communication.



**Abstract of the Disclosure**

The code space associated with the communication system is divided into at least two subspaces where each subspace is assigned to a different mode of operation. In one mode, such as a voice mode, each user is given full time access to a portion of the subspace associated with that mode of operation. In a second mode, such as a data mode, each user uses the entire subspace associated with that mode on a time shared basis. Additionally, in-sector handoffs from one Walsh code to another are used to more efficiently distribute the code space.

FIG. 1

$$W_1 = (+1)$$

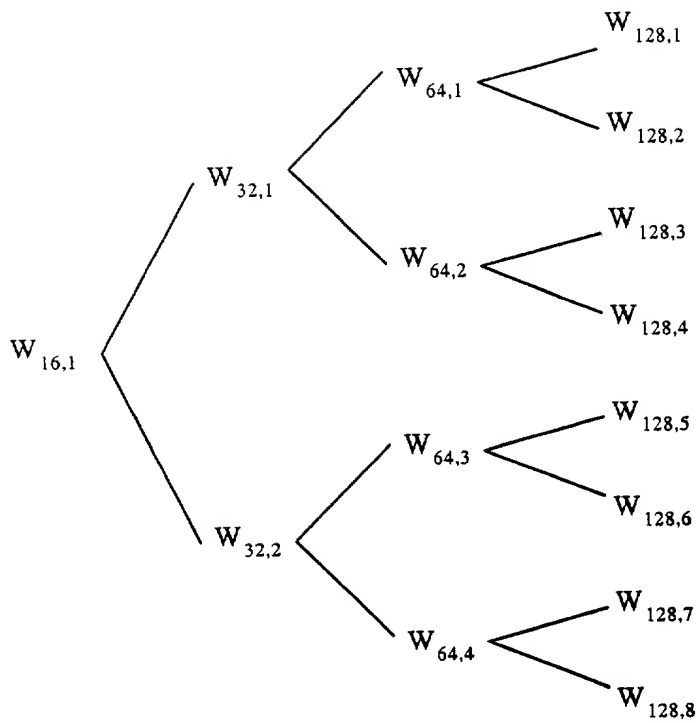
$$W_2 = \begin{bmatrix} +1 & +1 \\ +1 & -1 \end{bmatrix}$$

$$W_{2n} = \begin{bmatrix} W_n & W_n \\ W_n & \overline{W_n} \end{bmatrix}$$

FIG. 2

$$W_4 = \begin{bmatrix} +1 & +1 & +1 & +1 \\ +1 & -1 & +1 & -1 \\ +1 & +1 & -1 & -1 \\ +1 & -1 & -1 & +1 \end{bmatrix}$$

FIG 3



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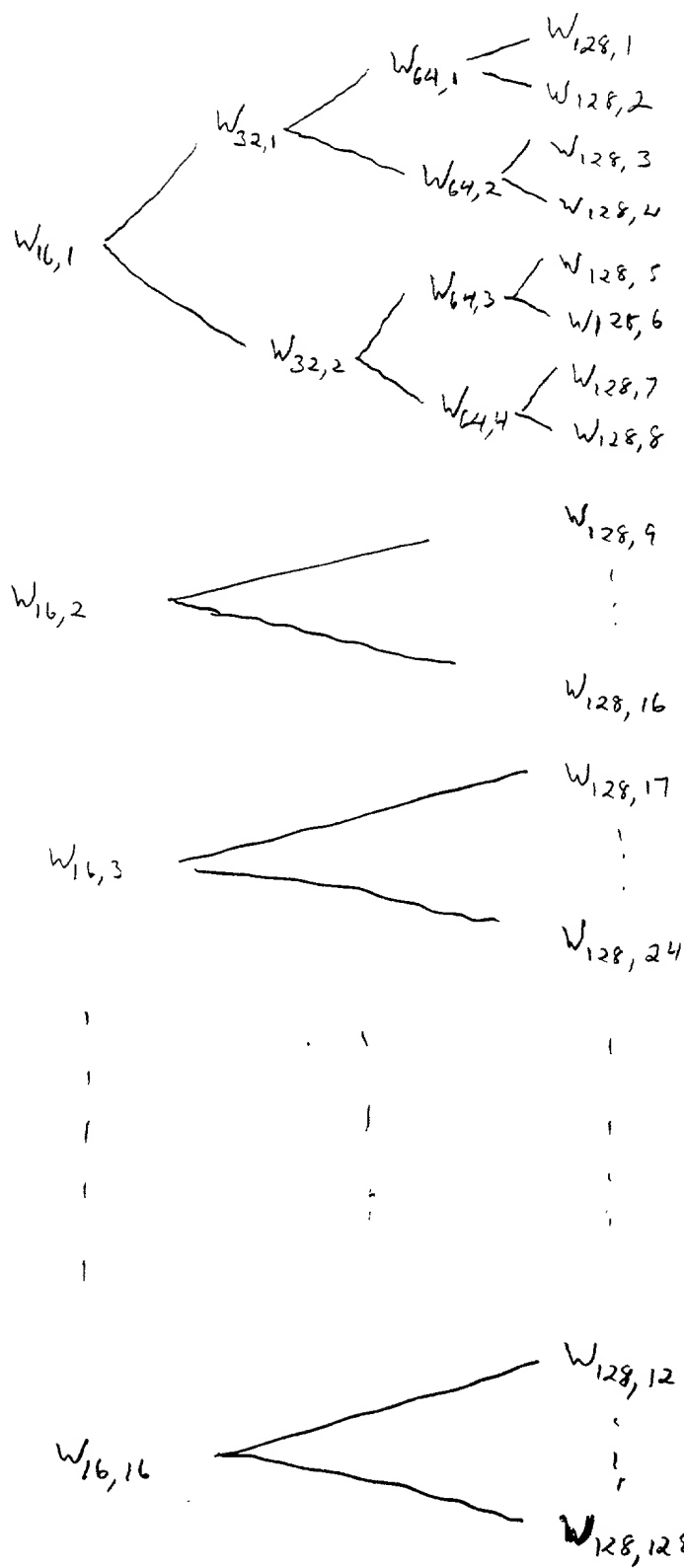


FIG 4



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Declaration and Power of Attorney

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am an original, first and joint inventor of the subject matter which is claimed and for which a patent is sought on the invention entitled **Dynamic Reassignment Of Code Space Among Multiple Modes Of Operation** the specification of which is attached hereto.

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by an amendment, if any, specifically referred to in this oath or declaration.

I acknowledge the duty to disclose all information known to me which is material to patentability as defined in Title 37, Code of Federal Regulations, 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, 119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

None

I hereby claim the benefit under Title 35, United States Code, 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, 112, I acknowledge the duty to disclose all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

None

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

I hereby appoint the following attorney(s) with full power of substitution and revocation, to prosecute said application, to make alterations and amendments therein, to receive the patent, and to transact all business in the Patent and Trademark Office connected therewith:

Thomas J. Bean	(Reg. No. 44528)
Lester H. Birnbaum	(Reg. No. 25830)
Richard J. Botos	(Reg. No. 32016)
Jeffery J. Brosemer	(Reg. No. 36096)
Kenneth M. Brown	(Reg. No. 37590)
Donald P. Dinella	(Reg. No. 39961)
Martin I. Finston	(Reg. No. 31613)
William S. Francos	(Reg. No. 38456)
Barry H. Freedman	(Reg. No. 26166)
Julio A. Garceran	(Reg. No. 37138)
Jimmy Goo	(Reg. No. 36528)
Anthony Grillo	(Reg. No. 36535)
Stephen M. Gurey	(Reg. No. 27336)
John M. Harman	(Reg. No. 38173)
Matthew J. Hodulik	(Reg. No. 36164)
Michael B. Johannesen	(Reg. No. 35557)
Mark A. Kurisko	(Reg. No. 38944)
Irena Lager	(Reg. No. 39260)
John B. MacIntyre	(Reg. No. 41170)
Christopher N. Malvone	(Reg. No. 34866)
John F. McCabe	(Reg. No. 42854)
Scott W. McLellan	(Reg. No. 30776)
Martin G. Meder	(Reg. No. 34674)
John C. Moran	(Reg. No. 30782)
Michael A. Morra	(Reg. No. 28975)
Gregory J. Murgia	(Reg. No. 41209)
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Joseph J. Opalach	(Reg. No. 36229)
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John P. Veschi	(Reg. No. 39058)
David Volejnicek	(Reg. No. 29355)
Charles L. Warren	(Reg. No. 27407)
Eli Weiss	(Reg. No. 17765)

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Please address all correspondence to the Docket Administrator (Rm. 3C-512), Lucent Technologies Inc., 600 Mountain Avenue, P. O. Box 636, Murray Hill, New Jersey 07974-0636. Telephone calls should be made to Christopher Malvone by dialing 973-386-2992.

Full name of 1st joint inventor: Ashok N. Rudrapatna

Inventor's signature Ashok N. Rudrapatna Date 9/12/2000

Residence: Basking Ridge, Somerset County, New Jersey

Citizenship: United States of America

Post Office Address: 34 Knollcroft Road  
Basking Ridge, New Jersey, 07920

Full name of 2<sup>nd</sup> inventor: Mehmet Oguz Sunay

Inventor's signature Mehmet Oguz Sunay Date 9/12/2000

Residence: Summit, Union County, New Jersey

Citizenship: Turkey

Post Office Address: 123 Summit Avenue #5  
Summit, New Jersey, 07901

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